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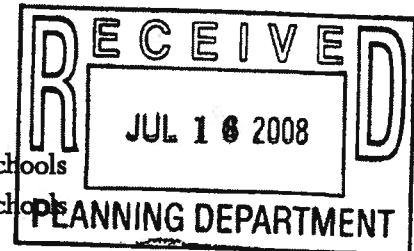
MEMORANDUM

TO: John Bassett
Marchant Schneider

VDOT
Loudoun County

CC: Sara Howard-O'Brien
Sam Adamo

Loudoun County Public Schools
Loudoun County Public Schools



FROM: Christopher Tacinelli, P.E.
Tushar Awar, P.E.
Cody Francis, P.E.

Bowman Consulting Group

DATE: July 16, 2008

SUBJECT: Response to Comments for Traffic Impact Study - Loudoun County Public Schools
Lenah Property MS-5 and HS-7; SPEX 2008-0017 and CMPT 2008-0007

This document addresses the comments by VDOT on the traffic impact study prepared for Loudoun County Public Schools, Lenah Property MS-5 and HS-7; SPEX 2008-0017 and CMPT 2008-0007, Loudoun County, Virginia. Each comment is presented in *italics* with the response in **bold** immediately following.

COMMENTS:

(Comments from John Bassett)

- 1) *Lenah Road, Route 600 should be constructed to the appropriate VDOT Geometric Standard (GS) along this site's entire frontage.*

As discussed in our meeting on June 5, 2008, we propose that two full paved lanes meeting current VDOT standards be constructed along the frontage of the site from the existing end of pavement to the end of the west school entrance to the school site, in lieu of providing half-section improvements along the entire frontage. As most of the traffic comes from either the southeast along Braddock Road and Lenah Village Drive, and from the northeast along Route 50 and Lenah Road, we believe this will provide adequate access to the site. Should the county require improvements beyond the school entrances, we propose to phase the improvements to allow adequate time for wetland permitting associated with construction west of the entrance.

- 2) *Lenah Road Connector should be constructed as specified (U4) in the Loudoun Countywide Transportation Plan (CTP) through the limits of this property if it is not in place by the school(s) planned opening date.*

The LCPS contract for the purchase of this site provides for the construction of a two lane Lenah Village Drive from Braddock Road to the school entrance at the southeast corner of the site. There will also be a second point of access on existing Lenah Road, providing access to the site from Route 50. With these two points of access and the internal connecting street, the schools will be provided with more than adequate access. The segment of Lenah Village Drive from the southern school entrance to existing Lenah Road, including the realignment of Lenah Drive to create a T-intersection with Lenah Village Drive, is to be constructed in conjunction with the residential subdivision. The contractual timing of this segment is within 14 months of the transfer of the 350th residential lot to a third party builder. The proposed subdivision seeks 499 lots. Ultimately, there will be two lanes of Lenah Village Drive from Braddock Road to Route 50. The additional two lanes for the planned four lane section of Lenah Village Drive between Tall Cedars Parkway and Route 50 would appropriately be provided when parties on the eastern frontage are re-developed. The traffic generated from the proposed school use does not warrant these additional two lanes.

- 3) *This applicant should construct or contribute significantly to the following road improvements as concluded in the associated Traffic Impact Study (TIS) dated February 15, 2008 in order that they be in place by the school(s) planned opening date.*

- (a) Intersection of Route 50 and Lenah Road - Add traffic signal*
- (b) Intersection of Route 50 and Lenah Road - Add westbound left turn lane*
- (c) Intersection of Route 50 and Lenah Road - Add eastbound right turn lane*
- (d) Intersection of Route 50 and Lenah Road - Add northbound right turn lane*
- (e) Intersection of Route 50 and Lenah Loop Road - Add eastbound through lane*
- (f) Intersection of Route 50 and Lenah Loop Road - Add westbound through lane*
- (g) Intersection of Route 15 and Braddock Road, Route 620 - Add Traffic signal*
- (h) Intersection of Route 15 and Braddock Road, Route 620 - Add southbound left lane*

(i) Intersection of Braddock Road and Lenah Loop Road — Add traffic signal.

The following improvements have been identified in the February 2008 traffic study that are recommended by 2011:

1. Intersection of Route 50 and Lenah Road:

- Addition of traffic signal
- Addition of westbound left turn bay
- Addition of northbound right turn bay
- Addition of eastbound right turn bay

The following tables show the % (fair share) of school traffic at the intersection of Route 50 and Lenah Road:

Route 50 and Lenah Road - Traffic Signal Required			
Scenario	Traffic Signal Warranted	Traffic Volume	% Share of Future Traffic 2011
Existing 2007	<input checked="" type="checkbox"/>	2,604	50%
Future Background 2010		4,580	88%
School Traffic 2011		619	12%
Total (2011)		5,246	100%

*Note: Calculations for fair share:

Existing Traffic: $2604/5246 = 50\%$

Existing + Background Traffic: $4580/5246 = 88\%$

School Traffic = $619/5246 = 12\%$

The traffic volume presented is the sum of AM and PM peak hour volumes

The traffic signal is warranted under the existing conditions with the existing volumes.

Route 50 and Lenah Road - Westbound Left Turn Lane Required			
Scenario	Turn Lane Warranted	Traffic Volume	% Share of Future Traffic 2011
Existing 2007	<input checked="" type="checkbox"/>	226	49%
Future Background 2010		226	49%
School Traffic 2011		237	51%
Total (2011)		463	100%

Route 50 and Lenah Road - Northbound Right Turn Lane Required

Scenario	Turn Lane Warranted	Traffic Volume	% Share of Future Traffic 2011
Existing 2007	<input checked="" type="checkbox"/>	209	55%
Future Background 2010		209	55%
School Traffic 2011 only		169	45%
Total (2011)		378	100%

Route 50 and Lenah Road - Eastbound Right Turn Lane Required

Scenario	Turn Lane Warranted	Traffic Volume	% Share of Future Traffic 2011
Existing 2007		13	9%
Future Background 2010		13	9%
School Traffic 2011 only		125	91%
Total (2011)	<input checked="" type="checkbox"/>	138	100%

The improvements identified above show that except for the eastbound right turn lane requirement, all other improvements identified at the intersection of Route 50 and Lenah Road are warranted without the proposed school traffic. The sequence in which the improvements are needed at the intersection, are given below:

- a. Traffic Signal (existing, unfunded need)
- b. Westbound left turn lane (existing, unfunded need)
- c. Northbound right turn lane (existing, unfunded need)
- d. Eastbound right turn lane (school related)

The applicant, Loudoun County Public Schools (LCPS), does not trigger the need for the first three improvements, however, has agreed to construct the westbound left turn lane and install a traffic signal at the intersection. The fair share percentage of the School traffic shown in the tables above shows that LCPS, by providing these improvements will not only offset its impacts, but will provide a regional contribution that will help alleviate an existing problem.

It is important to note that Middle Schools in Loudoun County run on the following schedule: 8:40 AM to 3:28 PM, whereas the High Schools run on the following schedule: 9:00 AM to 3:48 PM. The traffic study evaluates the worst-case scenario by analyzing traffic generated by the Schools with the peak hour of adjacent street

traffic. Traffic counts reveal that the peak hour of adjacent street traffic is between 7:00 to 8:00 in the AM peak period and 4:45 to 5:45 in the PM peak period, whereas the peak hour for the School traffic is between 8:00 to 9:00 AM and 4:00 to 5:00 PM. A revised analysis was conducted for 2011 (MS+HS traffic) for the peak hour of generator. The capacity analysis results for the intersection of Route 50 and Lenah Road are shown below:

Table A: Future Conditions with Development (2011) Intersection Capacity Analysis (Peak hour of Generator)

Intersection (Approach/Movement)	Total Future Conditions (2011)			
	AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Lenah Road				
Overall (Signalized)	D	44.5	C	31.0
Eastbound Approach	D	50.5	A	10.0
Westbound Approach – Add Left turn lane	C	32.5	D	40.3
Northbound Approach	D	53.3	D	49.2
Southbound Approach	C	30.2	D	44.9

The results presented above show that the intersection of Route 50 and Lenah Road operates at acceptable levels of service conditions for the peak hour of generator (AM and PM) with the addition of a traffic signal and a westbound left turn lane. LCPS has proffered these improvements at this intersection, which more than mitigate the impacts of the traffic generated by the Schools and solves a regional traffic issue. The Synchro analysis worksheets are shown in Appendix K.

2. Intersection of Route 15 and Braddock Road:

- Addition of traffic signal

The following tables show the % (fair share) of school traffic at the intersection of Route 15 and Braddock Road:

Route 15 and Braddock Road - Traffic Signal Required			
Scenario	Traffic Signal Warranted	Traffic Volume	% Share of Future Traffic 2011
Existing 2007	Not Warranted	2,314	68%
Future Background 2010	Not Warranted	3,313	98%
School Traffic 2011 only		59	2%
Total (2011)	Not Warranted	3,416	100%

As shown in the table above, the intersection of Braddock Road and Route 15 is not warranted (even with the proposed school traffic). Of note, the traffic generated by the proposed Schools using this intersection is approximately 2%, which is negligible.

The following improvements have been identified in the February 2008 traffic study that are recommended by 2020 (beyond the 2011 - School build out scenario):

3. Intersection of Route 50 and Lenah Loop Road:

- Addition of 2nd through lane in eastbound direction
- Addition of 2nd through lane in westbound direction

4. Intersection of Route 15 and Braddock Road:

- Addition of left turn lane in southbound direction

5. Intersection of Lenah Loop Road and Braddock Road:

- Addition of traffic signal

These improvements are required due to the addition of background traffic after the

full build out of the proposed middle school and high school. The 2020 (+10) scenario analysis is primarily required to provide projections for the future conditions beyond the full build out of the proposed development. Loudoun County's Facilities Standards Manual (FSM) recommends that mitigation measures should be recommended to maintain LOS 'D' up to the build out year, which in this case is 2011. The FSM also states that only traffic projections for future conditions beyond the full build out (+10 years scenario) of the proposed development are required. Although the traffic study identifies the improvements required for 2020 scenario, the applicant is not responsible for the implementation of these improvements. These improvements are triggered due to the background traffic and changes associated with the planned roadway improvements proposed in the area.

(Comments from Cina Debastani)

- 4) Existing counts (2007) at US 50 and Lenah Road seem low. Other studies within vicinity of this study area (Lenah Property submitted by Wells & Associates) are showing higher turning volumes for January 2008 actual counts. Update the existing counts accordingly or provide a set of fresh counts.

The traffic count for the intersection of Lenah Road and Route 50 was conducted in December 2007. The traffic study for Lenah Property shows that the traffic counts conducted by Wells & Associates at the same intersection were conducted in April 2007 not January 2008.

There were other intersections in the area that were included in the Lenah Property traffic study that were counted in January 2008, one of which was the intersection of Route 15 and Route 50. Gorove/Slade also had conducted counts at Route 15 and Route 50 in December 2007 (next major intersection to the west along Route 50). The comparison of this data revealed that there is no major discrepancy in the volumes.

However, Gorove/Slade has conducted spot counts at the intersection of Route 50 and Lenah Road on June 5, 2008 to check any discrepancy in the counts conducted in December 2007. The comparison of the latest data with the previous counts done in December 2007 indicates that the June 2008 counts increased in the westbound direction and decreased in the eastbound direction in the morning peak hour and vice versa in the afternoon peak hour. This implies that the latest traffic counts show that traffic increased in the non-commuter peak directions and decreased in the commuter peak directions for the AM and PM peak hour. The table below provides the summary:

Route 50 and Lenah Road	December 12, 2007		June 5, 2008		Percentage Difference	
	AM	PM	AM	PM	AM	PM
Eastbound Left *	2	0	1	0	-50%	0%
Eastbound Through	823	203	754	225	-8%	11%
Eastbound Right	8	5	4	12	-50%	140%
Westbound Left	28	198	44	130	57%	-34%
Westbound Through	276	821	310	776	12%	-14%
Westbound Right*	3	2	1	2	-67%	0%
Northbound Left	10	4	12	0	20%	-100%
Northbound Through*	0	1	0	0	0%	0%
Northbound Right	178	31	203	38	14%	23%
Southbound Left*	1	1	0	0	-100%	-100%
Southbound Through*	0	0	0	0	0%	0%
Southbound Right*	1	8	1	0	0%	-100%
Total Intersection Traffic	1,330	1,274	1,330	1,183	0%	- 7%

*Note: The northern leg at this intersection is a driveway, which serves a small business property (generating significantly lower trips)

The June 2008 spot counts are attached in Appendix A. Capacity analyses for future conditions with development (2011) were performed at the intersection of Route 50 and Lenah Road using the June 5, 2008 counts. The detailed capacity analysis worksheets are attached in Appendix B. The capacity analysis results were compared with the results presented in the February 2008 Traffic study. This comparison is presented in Table 1 below:

Table 1: Future Conditions with Development (2011) Intersection Capacity Analysis Comparison

Intersection (Approach/Movement)	Total Future Conditions (2011)			
	AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
US Route 50 and Lenah Road (December 12, 2007 GSA Counts)				
Overall (Signalized)	D	38.2	D	38.8
Eastbound Approach	D	46.1	B	11.9
Westbound Approach	C	24.2	D	52.5
Northbound Approach	D	39.2	D	37.9
Southbound Approach	D	38.9	D	42.8
US Route 50 and Lenah Road (June 05, 2008 GSA Counts)				
Overall (Signalized)	C	32.5	C	22.9
Eastbound Approach	C	31.0	B	11.9
Westbound Approach	C	31.0	C	28.4
Northbound Approach	D	40.0	D	37.7
Southbound Approach	D	38.7	A	0.0

As shown in Table 1, using the more recent counts (June 2008), the intersection of Route 50 and Lenah Road would operate at better levels of service (LOS C overall) as compared to the December 2007 counts (LOS D). Hence to present a more conservative scenario, the report was not updated with the recent spot counts.

- 5) *Show locations of the background developments (appendix E shows the trips generated at each intersection of this study area but it is not showing the location of each background development). Lenah Property development is right next to this development and is missing from the provided list of background developments since it is not approved yet, however, it needs to be added for it has direct impact on the same roadways.*

Comment acknowledged. Figure A is attached in Appendix C and shows the locations of the background developments. In addition, the Lenah Property development was assumed under the background scenario, the location of the development is shown in Figure A.

- 6) *Provide map showing school district's boundary and if possible superimpose it on Loudoun County's TAZ map showing land use for 2010, 2011, and 2020 to identify and document the distributions more accurately.*

Please find attached in Appendix D a map of the Lenah Property Transportation Study Area (proposed MS 5 and HS7 site) with the Transportation Analysis Zones (TAZ) per VDOT's request.

(Comments from Alex Faghri)

- 7) Why "number of employees" was not considered as the parameter to determine the traffic generation numbers?

The ITE trip generation manual does not have trip generation rates based on 'number of employees' for the Middle School. The trip generation rates are available only for the High School.

The standard deviation for the High School data (based on number of employees) is 2.84. The value 2.84 (284%) shows that the data is unreliable and is not recommended to use. Based on the administrative guidelines provided in the Chapter 527 TIA regulations, either a regression equation or average rate should be used, provided the data set meets certain conditions. In the case of High School data (based on number of employees), the trip generation manual does not have a regression equation, but provides an average rate of 4.83. In order to use the average rate the following conditions must be met:

- a. At least three data points exist; (52 points exist - OK)
- b. Standard deviation less than 110% of weighted average rate; (61% - OK)
- c. R^2 less than 0.75 or weighted average rate falls within data cluster in plot. (R^2 not available and weighted average rate line is not within data cluster at site's number of employees.)

An example problem has been presented in the "Trip Generation Handbook, 2nd Edition", published by Institute of Transportation Engineers for calculating trips generated by a High School based on number of employees. The example solution concludes that the data is unreliable to use. The example problem has been attached in Appendix E.

Of note, the trip generation data provided for High School based on 'number of students' meets the conditions provided in ITE's trip generation handbook and Chapter 527 regulations.

- 8) All signal warrant analyses should use "urban" thresholds.

Comment acknowledged. VDOT's designation for the study area is 'rural'. At your request, updated warrant analyses sheets are attached in Appendix F.

- Intersection of Route 50 and Lenah Road (Warranted - No Change)

- Intersection of Route 15 and Braddock Road (Not Warranted using urban thresholds)

- 9) *Considering majority of vehicles accessing site driveways (Intersections 4, 7, and 8) will be school buses, passenger car equivalency factor should be applied when determining warrants for left and right turn lanes. The number of school buses affect the critical gap and follow-up time ensuing longer delays and queues at these intersections.*

The critical gap calculated by the HCM/Synchro methodology is excessive for stop-controlled intersections. Spot checks from other projects suggest that if the gap criteria for the stop-controlled minor street are reduced by 25% from the defaults assigned by Synchro, the delay results will approximate field conditions. However, the critical gap and follow up time for the site driveways (Intersections 4, 7 and 8) were increased by 25% in order to account for the school bus traffic. The revised capacity analysis HCM results are attached in Appendix G. The left turn and right turn lane at the site entrances were not required based on the revised capacity analysis.

As previously reported in the February 2008 report, the turn lanes at the site entrances are not warranted. Additional analysis was carried out for the intersection of Lenah Loop Road and Site Drive #3 (intersection 8) for 2020 Total Future Conditions. The analysis shows that the intersection does not warrant both northbound left and southbound right turn lane. The analysis is attached in Appendix G

Hence, there are no changes to the results reported in the February 2008 traffic study.

According to VDOT's "Road Design Manual" Table C-1-2.1 (attached in Appendix G), based on the passenger car equivalence factor (PCE), additional storage length is added to the storage length determined from the charts for left-turn lanes. Since none of the site intersections are warranted for left and right turn lanes, the PCE factor was not taken into account.

- 10) *Judging by the aerial photo, Intersection 1 (Braddock road and Rt. 15) does not have a separate northbound right turn lane. The Synchro model, however, shows an extended right turn lane at his approach. Please fix the model to show the correct lane configuration.*

There is an existing northbound right turn bay at the intersection of Braddock Road and Route 15. The storage length was not included in the model. The model has been updated. There was no change observed in the HCM results.

- 11) The southbound right turn lane at Intersection 3 (Lenah Road and Lenah run Circle North) does not extend all the way to the upstream intersection. Please input the correct turn bay length in Synchro.*

Comment acknowledged. The storage length has been entered. There was no change observed in the HCM results.

- 12) LOS information is wrongly depicted on Figure 5 for Intersections 1, and 2. The information on Table 1 which contains the LOS information for existing conditions is accurate; however, Figure 5 which is the graphical representation of existing LOS is not accurately shown.*

Comment acknowledged. Revised Figure 5 is attached in Appendix H.

- 13) Figures E-1 thru E-5 show traffic generated by other developments with approved TIAs in the neighboring area. Please show the location of these future developments with respect to the site.*

Please refer to response for Comment # 7.

- 14) Appendix J node 12 (Rt. 50 and Lenah) 2010 TF PM (with Lenah Loop Road Connection) scenario shows LOS E for the WBT movement. Mitigation measures should be provided to improve LOS at any movement below LOS D.*

Per Loudoun County's Facilities Standards Manual (FSM), the standards for acceptable levels of service are LOS D by approach. The intersection of Route 50 with Lenah Road operates at acceptable levels of service; hence no mitigation measures were suggested.

- 15) Appendix K node 12 (Rt. 50 and Lenah) 2011 TF AM scenario shows LOS F for EB, NB and total intersection LOS, however Figure 20 shows LOS D or better. Please verify that the LOS are depicted correctly on figures.*

Appendix K node 12 reports LOS for 2011 AM scenario. Mitigation measures have been suggested and reported in Appendix K under 2011 AM 'Mitigated' scenario. Figure D reports the mitigated LOS, which is LOS D and better. The HCM results for node 12 (Route 50 and Lenah Road) for 2011 AM 'Mitigated' scenario are attached in Appendix I.

- 16) Appendix K node 12 (Rt. 50 and Lenah) 2011 TF PM scenario shows LOS E for the WBT movement as well as the EB approach. Mitigation measures should be provided to improve LOS at any movement below LOS D.*

Appendix K node 12 reports LOS for 2011 PM scenario. Mitigation measures were suggested and reported in Appendix K under 2011 PM 'Mitigated' scenario. The HCM results for node 12 (Route 50 and Lenah Road) for 2011 PM 'Mitigated' scenario are attached in Appendix J.

- 17) Appendix K node 12 (Rt. 50 and Lenah) 2011 TF AM (mitigated) scenario shows LOS E for the WBL movement. Mitigation measures should be provided to improve LOS at any movement below LOS D.*

Please refer to response for comment #14.



APPENDIX



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APPENDIX D

School District's Boundary Map and Direction of Approach Estimations

APPENDIX E

ITE "Trip Generation Handbook, 2nd Edition" Sample Problem.

APPENDIX F

Signal Warrants

APPENDIX G

Intersection Capacity Analysis Results – Future Conditions with Proposed Development (2011) (Intersections 4, 7, and 8); Turn Lane Warrants (intersection 8); Table C-1-2.1 from VDOT's "Road Design Manual".

APPENDIX H

Figure 5: Existing (2007) AM/PM Peak Hour Levels of Service

APPENDIX I

Intersection Capacity Analysis Results for Node 12 (Rt. 50 and Lenah) – Future Conditions with Proposed Development (2011 AM)



APPENDIX J

Intersection Capacity Analysis Results for Node 12 (Rt. 50 and Lenah) – Future Conditions with Proposed Development (2011 PM)

APPENDIX K

Intersection Capacity Analysis Results for Node 12 (Rt. 50 and Lenah) – Future Conditions with Proposed Development (2011) using Peak Hour of Generator



APPENDIX A

EXISTING (2007 AND 2008) TRAFFIC VOLUMES & COUNT SHEETS

Garono/Slade Associates
 Project Name :
 Location :
 Date :
 Location :
 Location :

Lenah School
 0
 Loudoun County
 Garono/Slade Associates

Data Source		Garver/Stadt Associates		Lenah Road at Route 50													
Intersection:		Southbound Lenah Road				Westbound Rte. 50				Northbound Lenah Road				Eastbound Rte. 50			
Direction/Route/ Movement:		Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds
AM PEAK																	
6:00 AM to 6:15 AM		0	0	0	0	0	25	1	0	17	0	1	0	0	278	0	0
6:15 AM to 6:30 AM		0	0	0	0	0	41	0	0	30	0	3	0	1	224	0	0
6:30 AM to 6:45 AM		0	0	1	0	0	48	2	0	31	0	3	0	1	255	0	0
6:45 AM to 7:00 AM		1	0	0	0	0	52	8	0	32	0	2	0	0	237	0	0
7:00 AM to 7:15 AM		1	0	0	0	0	53	13	0	28	0	1	0	4	235	0	0
7:15 AM to 7:30 AM		0	0	0	0	2	63	7	0	52	0	2	0	2	182	0	0
7:30 AM to 7:45 AM		0	0	0	0	1	73	4	0	44	0	4	0	2	230	0	0
7:45 AM to 8:00 AM		0	0	1	0	0	87	4	0	54	0	3	0	0	188	2	0
8:00 AM to 8:15 AM		0	0	0	0	0	75	7	0	50	0	7	0	5	157	0	0
8:15 AM to 8:30 AM		0	1	0	0	0	81	3	0	31	0	5	0	4	183	0	0
8:30 AM to 8:45 AM		1	0	1	0	0	93	8	0	28	0	4	0	2	189	0	0
8:45 AM to 9:00 AM		0	0	0	0	3	78	5	0	17	0	5	0	0	148	0	0
PM PEAK																	
Direction/Route/ Movement:		Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds
4:00 PM to 4:15 PM		1	0	0	0	1	210	37	0	8	0	1	0	1	46	0	0
4:15 PM to 4:30 PM		0	0	0	0	0	217	29	0	10	4	0	1	45	0	0	0
4:30 PM to 4:45 PM		0	0	5	0	2	220	28	0	10	1	3	0	2	39	0	0
4:45 PM to 5:00 PM		0	0	0	0	0	197	47	0	6	0	2	0	3	50	0	0
5:00 PM to 5:15 PM		0	0	0	0	2	205	46	0	7	0	0	0	2	54	0	0
5:15 PM to 5:30 PM		1	0	1	0	0	218	50	0	11	0	2	0	0	48	0	0
5:30 PM to 5:45 PM		7	0	0	0	0	201	53	0	7	1	0	0	0	51	0	0
5:45 PM to 6:00 PM		2	0	1	0	1	141	33	0	8	0	0	0	43	0	0	0
6:00 PM to 6:15 PM		2	0	2	0	0	108	20	0	9	5	1	0	0	50	0	0
6:15 PM to 6:30 PM		2	0	0	0	1	151	34	0	11	0	2	0	0	38	0	0
6:30 PM to 6:45 PM		5	0	1	0	2	151	37	0	5	5	0	0	0	59	0	0
6:45 PM to 7:00 PM		1	0	0	0	1	153	44	0	8	0	3	0	0	27	0	0
PM HOURS																	
Direction/Route/ Movement:		Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds
AM INTERSECTION PEAK HOUR																	
6:45 AM to 7:45 AM		2	0	0	0	8	241	52	0	166	0	9	0	8	894	0	0
PM INTERSECTION PEAK HOUR																	
6:45 PM to 8:45 PM		8	0	1	0	2	821	136	0	31	1	4	0	5	203	0	0
AM SYSTEM PEAK HOUR																	
7:00 AM to 8:00 AM		1	0	1	0	8	276	26	0	178	0	10	0	8	823	2	0
PM SYSTEM PEAK HOUR																	
8:45 PM to 9:45 PM		8	0	1	0	2	821	136	0	31	1	4	0	5	203	0	0
PM HOURS																	
Direction/Route/ Movement:		Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds
AM PEAK HOUR		0.25	0.00	0.25	N/A	0.38	0.79	0.84	N/A	0.82	0.00	0.83	N/A	0.90	0.88	0.25	N/A
PM PEAK HOUR		0.29	0.00	0.25	N/A	0.25	0.50	0.50	N/A	0.70	0.25	0.50	N/A	0.42	0.94	0.00	N/A
Overall AM PEAK HOUR FACTOR		= 0.93															
Overall PM PEAK HOUR FACTOR		= 0.96															
Overall AM PEAK HOUR FACTOR		= 0.93															
Overall PM PEAK HOUR FACTOR		= 0.96															

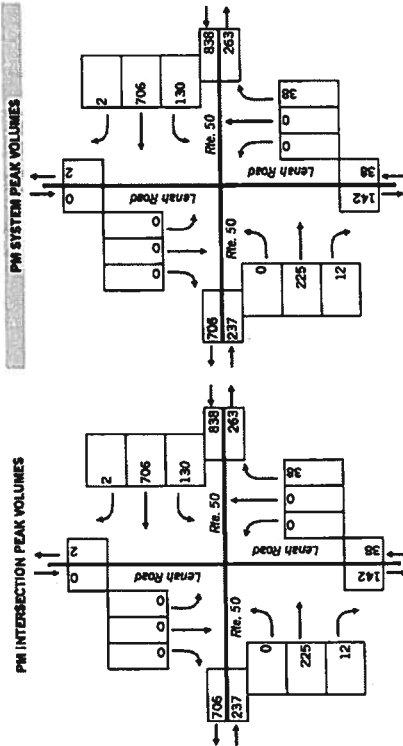
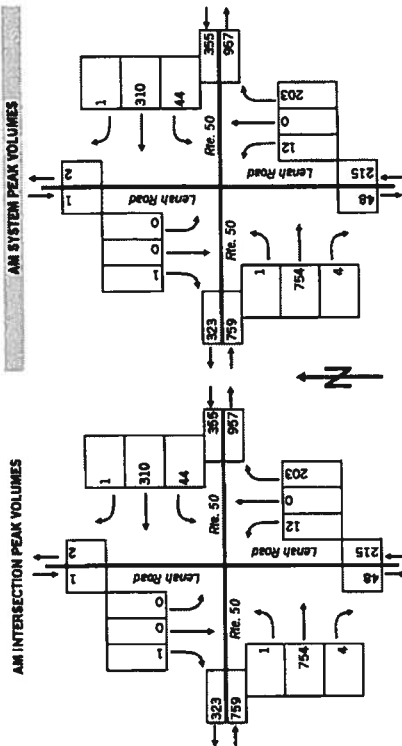
Geos/Slide Associates

Project Name :
 Project # :
 Location :
 Data Source :

Lenah School
 0
 Loudoun County
 Geos/Slide Associates

Lenah Road at Route 50													
Intersections:	Direction/ Analysis/ Movement	Southbound Lenah Road			Westbound Rte. 50			Northbound Lenah Road			Eastbound Rte. 50		
		Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left
AM PEAK	6:00 AM to 6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
	6:15 AM to 6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
	6:30 AM to 6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
	6:45 AM to 7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
	7:00 AM to 7:15 AM	0	0	0	79	10	0	35	0	2	0	189	0
	7:15 AM to 7:30 AM	1	0	0	69	8	0	68	0	1	0	4	189
	7:30 AM to 7:45 AM	0	0	0	1	81	12	0	53	0	3	0	179
	7:45 AM to 8:00 AM	0	0	0	0	81	14	0	47	0	6	0	187
	8:00 AM to 8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
	8:15 AM to 8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
	8:30 AM to 8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
	8:45 AM to 9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
PM PEAK	4:00 PM to 4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
	4:15 PM to 4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
	4:30 PM to 4:45 PM	0	0	0	0	158	25	0	9	0	0	0	0
	4:45 PM to 5:00 PM	0	0	0	0	172	22	0	5	0	0	4	84
	5:00 PM to 5:15 PM	0	0	0	2	218	43	0	11	0	0	4	84
	5:15 PM to 5:30 PM	0	0	0	0	158	40	0	13	0	0	4	57
	5:30 PM to 5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
	5:45 PM to 6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
	6:00 PM to 6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
	6:15 PM to 6:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
	6:30 PM to 6:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
	6:45 PM to 7:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
PEAK HOURS	Direction/ Analysis/ Movement	Southbound Lenah Road			Westbound Rte. 50			Northbound Lenah Road			Eastbound Rte. 50		
	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	
	AM INTERSECTION PEAK HOUR												
	1	0	0	1	310	44	0	203	0	12	0	4	754
	PM INTERSECTION PEAK HOUR												
	0	0	0	2	706	130	0	38	0	0	0	12	225
	AM SYSTEM PEAK HOUR												
	1	0	0	1	310	44	0	203	0	12	0	4	754
	PM SYSTEM PEAK HOUR												
	0	0	0	2	706	130	0	38	0	0	0	12	225
	4:45 PM to 5:45 PM												
	0	0	0	2	706	130	0	38	0	0	0	12	225
PEAK HOUR FACTORS	Direction/ Analysis/ Movement	Southbound Lenah Road			Westbound Rte. 50			Northbound Lenah Road			Eastbound Rte. 50		
	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	
	0.25	0.00	0.00	0.25	0.96	0.79	N/A	0.75	0.00	0.90	N/A	0.25	
	0.00	0.00	0.00	0.25	0.81	0.76	N/A	0.75	0.00	0.00	N/A	0.67	
	Overall AM PEAK HOUR FACTOR	= 0.95			= 0.95			= 0.95			= 0.77		
Overall PM PEAK HOUR FACTOR = 0.77													
Overall Intersection Volume: 1115													

Date of Counts: Thursday, June 05, 2008
 AM Weather Conditions: Cool, Cloudy
 PM Weather Conditions: Cool, Light Rain
























APPENDIX B

INTERSECTION CAPACITY ANALYSIS COMPARISON RESULTS –
EXISTING CONDITIONS




















HCM Signalized Intersection Capacity Analysis
12: Route 50 & Lenah Road

Lenah Schools
6/18/2008

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Fr _t		1.00	0.85	1.00	1.00			1.00	0.85		0.93	
Flt Protected		1.00	1.00	0.95	1.00			0.95	1.00		0.98	
Satd. Flow (prot)		1863	1583	1770	1861			1770	1583		1695	
Flt Permitted		1.00	1.00	0.06	1.00			0.76	1.00		0.90	
Satd. Flow (perm)		1862	1583	106	1861			1409	1583		1563	
Volume (vph)	2	1159	108	218	525	3	73	0	299	1	0	1
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	1260	117	237	571	3	79	0	325	1	0	1
RTOR Reduction (vph)	0	0	37	0	0	0	0	0	67	0	1	0
Lane Group Flow (vph)	0	1262	80	237	574	0	0	79	258	0	1	0
Turn Type	Perm		Perm	pm+pt			Perm		pm+ov	Perm		
Protected Phases		2		1	6			8	1		4	
Permitted Phases	2		2	6			8		8	4		
Actuated Green, G (s)		65.0	65.0	79.2	79.2			10.8	20.0		10.8	
Effective Green, g (s)		66.0	66.0	80.2	80.2			11.8	22.0		11.8	
Actuated g/C Ratio		0.66	0.66	0.80	0.80			0.12	0.22		0.12	
Clearance Time (s)		5.0	5.0	5.0	5.0			5.0	5.0		5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		1229	1045	255	1493			166	412		184	
v/s Ratio Prot				c0.09	0.31				c0.06			
v/s Ratio Perm		c0.68	0.05	0.65				0.06	0.10		0.00	
v/c Ratio		1.03	0.08	0.93	0.38			0.48	0.63		0.01	
Uniform Delay, d1		17.0	6.1	36.7	2.8			41.2	35.3		38.9	
Progression Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2		32.7	0.1	37.3	0.8			2.1	3.0		0.0	
Delay (s)		49.7	6.2	74.0	3.6			43.4	38.2		38.9	
Level of Service		D	A	E	A			D	D		D	
Approach Delay (s)		46.1			24.2			39.2			38.9	
Approach LOS		D			C			D			D	
Intersection Summary												
HCM Average Control Delay			38.2			HCM Level of Service				D		
HCM Volume to Capacity ratio			0.97									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			106.1%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												




















HCM Signalized Intersection Capacity Analysis
12: Route 50 & Lenah Road

Lenah Schools
6/18/2008

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00			1.00	0.85		0.88	
Flt Protected		1.00	1.00	0.95	1.00			0.95	1.00		1.00	
Satd. Flow (prot)		1863	1583	1770	1862			1777	1583		1628	
Flt Permitted		1.00	1.00	0.17	1.00			0.73	1.00		0.97	
Satd. Flow (perm)		1863	1583	320	1862			1352	1583		1588	
Volume (vph)	0	892	30	245	1570	2	29	1	79	1	0	8
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	970	33	266	1707	2	32	1	86	1	0	9
RTOR Reduction (vph)	0	0	9	0	0	0	0	0	72	0	8	0
Lane Group Flow (vph)	0	970	24	266	1709	0	0	33	14	0	2	0
Turn Type	Perm		Perm	pm+pt			Perm		pm+ov	Perm		
Protected Phases		2		1	6			8	1		4	
Permitted Phases	2		2	6			8		8	4		
Actuated Green, G (s)		70.3	70.3	83.4	83.4			6.6	14.7		6.6	
Effective Green, g (s)		71.3	71.3	84.4	84.4			7.6	16.7		7.6	
Actuated g/C Ratio		0.71	0.71	0.84	0.84			0.08	0.17		0.08	
Clearance Time (s)		5.0	5.0	5.0	5.0			5.0	5.0		5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		1328	1129	402	1572			103	328		121	
v/s Ratio Prot		0.52		0.06	0.92				0.00			
v/s Ratio Perm			0.01	0.50				0.02	0.01		0.00	
v/c Ratio		0.73	0.02	0.66	1.09			0.32	0.04		0.01	
Uniform Delay, d1		8.6	4.2	11.9	7.8			43.8	35.0		42.7	
Progression Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2		3.6	0.0	4.1	50.3			1.8	0.1		0.0	
Delay (s)		12.2	4.2	15.9	58.1			45.6	35.0		42.8	
Level of Service		B	A	B	E			D	D		D	
Approach Delay (s)		11.9			52.5			37.9			42.8	
Approach LOS		B			D			D			D	
Intersection Summary												
HCM Average Control Delay			38.8			HCM Level of Service			D			
HCM Volume to Capacity ratio			1.02									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			148.0%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												





















HCM Signalized Intersection Capacity Analysis
12: Route 50 & Lenah Road

Lenah Schools
6/18/2008

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00			1.00	0.85		0.86	
Flt Protected		1.00	1.00	0.95	1.00			0.95	1.00		1.00	
Satd. Flow (prot)		1863	1583	1770	1862			1770	1583		1611	
Flt Permitted		1.00	1.00	0.06	1.00			0.76	1.00		1.00	
Satd. Flow (perm)		1862	1583	106	1862			1410	1583		1611	
Volume (vph)	1	1084	104	234	562	1	75	0	324	0	0	1
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	1178	113	254	611	1	82	0	352	0	0	1
RTOR Reduction (vph)	0	0	38	0	0	0	0	0	80	0	1	0
Lane Group Flow (vph)	0	1179	75	254	612	0	0	82	272	0	0	0
Turn Type	Perm		Perm	pm+pt			Perm		pm+ov		Perm	
Protected Phases		2		1	6			8	1			4
Permitted Phases	2		2	6			8		8	4		
Actuated Green, G (s)		65.0	65.0	79.0	79.0			11.0	20.0		11.0	
Effective Green, g (s)		66.0	66.0	80.0	80.0			12.0	22.0		12.0	
Actuated g/C Ratio		0.66	0.66	0.80	0.80			0.12	0.22		0.12	
Clearance Time (s)		5.0	5.0	5.0	5.0			5.0	5.0		5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		1229	1045	251	1490			169	412		193	
v/s Ratio Prot				c0.10	0.33				c0.07		0.00	
v/s Ratio Perm		0.63	0.05	c0.70				0.06	0.11			
v/c Ratio		0.96	0.07	1.01	0.41			0.49	0.66		0.00	
Uniform Delay, d1		15.8	6.1	36.8	3.0			41.1	35.6		38.7	
Progression Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2		17.6	0.1	59.9	0.8			2.2	3.8		0.0	
Delay (s)		33.4	6.2	96.7	3.8			43.3	39.4		38.7	
Level of Service		C	A	F	A			D	D		D	
Approach Delay (s)		31.0			31.0			40.1			38.7	
Approach LOS		C			C			D			D	
Intersection Summary												
HCM Average Control Delay			32.5			HCM Level of Service			C			
HCM Volume to Capacity ratio			0.96									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			107.6%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
12: Route 50 & Lenah Road

Lenah Schools
6/18/2008

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0			4.0	4.0			
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00	1.00			
Frt		1.00	0.85	1.00	1.00			1.00	0.85			
Flt Protected		1.00	1.00	0.95	1.00			0.95	1.00			
Satd. Flow (prot)		1863	1583	1770	1862			1770	1583			
Flt Permitted		1.00	1.00	0.16	1.00			0.76	1.00			
Satd. Flow (perm)		1863	1583	306	1862			1410	1583			
Volume (vph)	0	916	37	177	1445	2	25	0	86	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	996	40	192	1571	2	27	0	93	0	0	0
RTOR Reduction (vph)	0	0	11	0	0	0	0	0	78	0	0	0
Lane Group Flow (vph)	0	996	29	192	1573	0	0	27	15	0	0	0
Turn Type	Perm		Perm	pm+pt			Perm		pm+ov	Perm		
Protected Phases		2		1	6			8	1		4	
Permitted Phases	2		2	6			8		8	4		
Actuated Green, G (s)		71.0	71.0	83.5	83.5			6.5	14.0			
Effective Green, g (s)		72.0	72.0	84.5	84.5			7.5	16.0			
Actuated g/C Ratio		0.72	0.72	0.84	0.84			0.08	0.16			
Clearance Time (s)		5.0	5.0	5.0	5.0			5.0	5.0			
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0	3.0			
Lane Grp Cap (vph)		1341	1140	383	1573			106	317			
v/s Ratio Prot		0.53		0.04	c0.84				0.00			
v/s Ratio Perm			0.02	0.38				c0.02	0.01			
v/c Ratio		0.74	0.03	0.50	1.00			0.25	0.05			
Uniform Delay, d1		8.4	4.0	10.5	7.8			43.6	35.5			
Progression Factor		1.00	1.00	1.00	1.00			1.00	1.00			
Incremental Delay, d2		3.8	0.0	1.0	22.7			1.3	0.1			
Delay (s)		12.2	4.0	11.5	30.4			44.9	35.6			
Level of Service		B	A	B	C			D	D			
Approach Delay (s)		11.9			28.4			37.7			0.0	
Approach LOS		B			C			D			A	
Intersection Summary												
HCM Average Control Delay			22.9			HCM Level of Service			C			
HCM Volume to Capacity ratio			0.94									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			137.7%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												



APPENDIX C

LOCATION OF APPROVED BACKGROUND DEVELOPMENTS

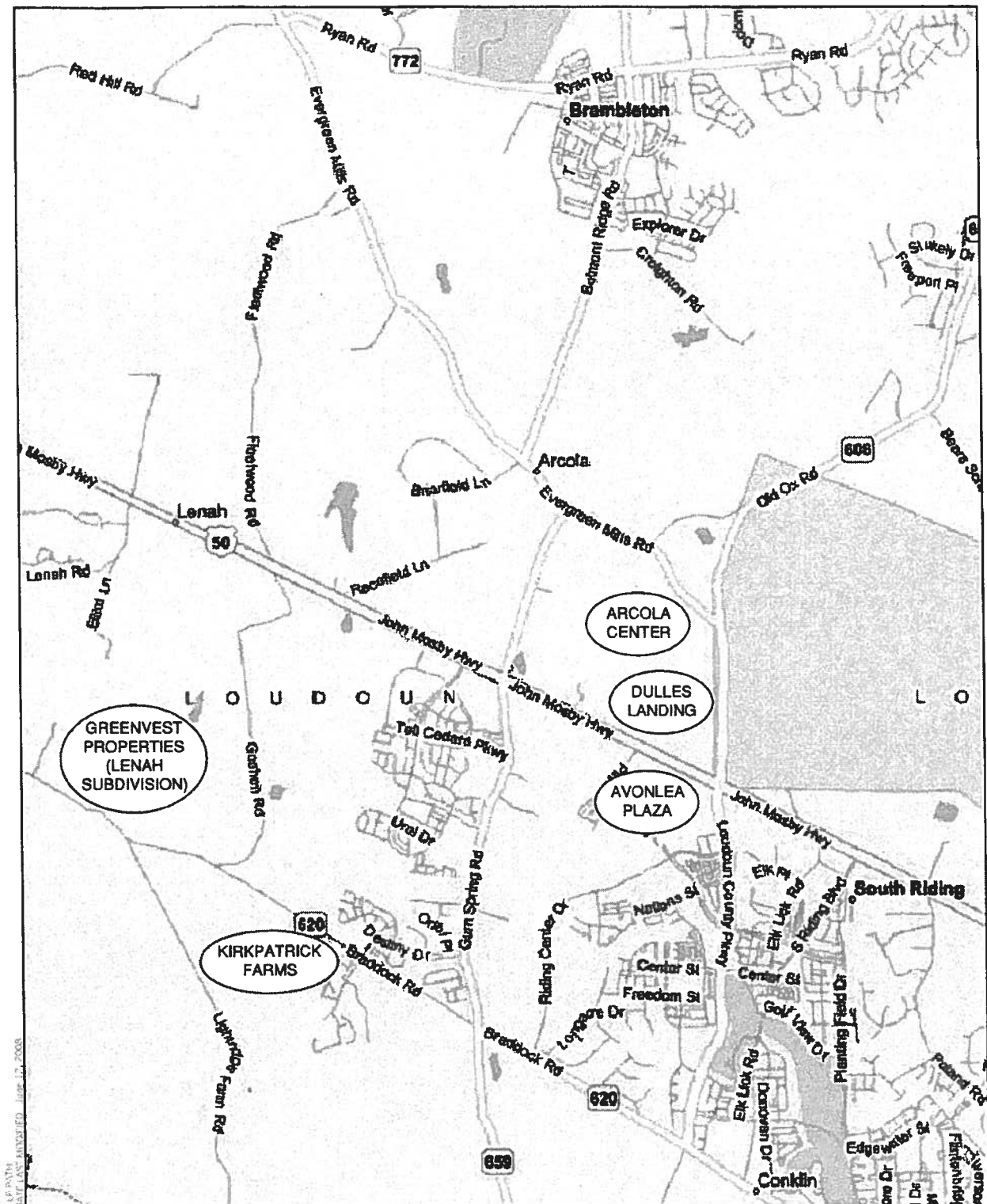


Figure A
Locations of Other Approved Background Development

June 13, 2008



APPENDIX D

SCHOOL DISTRICT'S BOUNDARY MAP AND DIRECTION OF APPROACH ESTIMATIONS

ROADS

TRAFFIC ANALYSIS ZONES



Projected MS Students by Planning Zone (Reference: FY09-14 CIP)						
Planning Zone	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
	1468	1702	1923	2274	2661	3058
DS04	16	19	28	37	46	55
DS04.1	9	10	12	14	16	18
DS05	8	8	9	10	11	12
DS06	60	96	131	170	207	244
DS06.1	5	5	6	8	9	10
DS06.2	2	1	2	3	3	3
DS06.3	0	0	0	0	0	0
DS07	18	40	59	85	103	124
DS07.1	5	16	26	37	49	56
DS07.2	30	60	86	116	149	175
DS09	18	32	45	59	77	89
DS10	55	62	63	74	78	86
DS12	3	4	4	5	6	6
DS12.1	38	42	49	50	52	55
DS12.2	40	43	46	48	53	58
DS12.3	4	13	26	39	58	76
DS12.4	3	6	10	16	26	37
DS13	155	153	165	197	205	221
DS13.1	14	13	12	15	17	21
DS13.2	73	87	105	123	169	198
DS13.3	58	64	70	77	96	110
DS13.4	39	44	43	45	51	63
DS13.5	17	17	20	19	20	29
DS13.6	39	39	44	48	52	60
DS14	310	350	355	419	476	522
DS14.1	69	63	64	74	83	95
DS14.2	26	21	23	32	42	55
DS14.3	117	155	158	163	173	189
DS14.4	33	35	37	40	42	55
DS16	72	72	76	76	96	107
DS16.1	19	18	20	20	27	37
DS16.2	2	1	0	0	0	0
DS17	111	113	129	155	169	192
DS18	0	0	0	0	0	0
	1468	1702	1923	2274	2661	3058
		MS-5	1027	1267	1515	1736
		Mercer MS	896	1007	1146	1322
			1923	2274	2661	3058

Projected HS Students by Planning Zone (Reference: FY09-14 CIP)						
Planning Zone	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
	1442	1745	2114	2491	2879	3269
DS04	15	17	21	27	30	33
DS04.1	8	9	12	15	17	21
DS05	13	7	9	9	9	14
DS06	26	38	63	89	116	139
DS06.1	7	6	5	6	7	10
DS06.2	5	5	4	5	3	3
DS06.3	0	0	0	0	0	0
DS07	4	8	17	30	41	56
DS07.1	0	2	6	13	19	25
DS07.2	2	9	23	42	60	78
DS09	5	10	19	25	35	43
DS10	48	66	85	98	112	127
DS12	8	8	5	5	3	5
DS12.1	40	42	52	61	63	68
DS12.2	34	49	60	61	69	73
DS12.3	1	4	7	15	25	35
DS12.4	3	4	3	7	11	16
DS13	151	207	234	262	292	317
DS13.1	16	20	21	23	25	27
DS13.2	89	103	120	142	157	171
DS13.3	72	77	87	101	110	135
DS13.4	51	58	59	66	75	84
DS13.5	17	22	27	27	32	39
DS13.6	47	52	53	64	73	81
DS14	296	360	469	547	630	701
DS14.1	52	71	86	102	122	124
DS14.2	29	33	41	41	50	57
DS14.3	132	152	183	208	251	281
DS14.4	38	44	42	52	60	69
DS16	76	80	98	120	128	148
DS16.1	18	15	22	29	32	42
DS16.2	1	2	2	2	2	1
DS17	137	166	177	200	219	245
DS18	0	0	0	0	0	0
	1442	1745	2114	2491	2879	3269
			HS-7	1154	1362	1582
			Freedom HS	1337	1517	1687
				2491	2879	3269
	2011-12 Projected HS-7 Enrollment*			1154	(Grades 9-12)	
				866	(Grades 9-11)	
	* HS-7 enrollment for the first year will likely reflect students in grades 9 through 11 only; there will be no grade 12 students attending HS-7 for the 2011-12 school year. For this estimate, the projected enrollment for HS-7 was reduced by 25%.					

HIGH SCHOOL DOA ESTIMATION FOR 2011-12														
DS Zones	Students	Direction of Approach for each Zone					Traffic Generated from Each Zone							
		NB Rte 15	SB Rte 15	EB Rte 50	WB Rte 50	Lenah Run Circle	NB Rte 15	SB Rte 15	EB Rte 15	WB Rte 50	Braddock Braddock	WB Braddock	EB Braddock	Lenah Run Circle
DS4.0	27	67%	67%	33%	33%		0	18	9	0	0	0	0	0
DS04.1	15		67%	33%	33%		0	10	5	0	0	0	0	0
DS05	9	67%		33%	33%		6	0	3	0	0	0	0	0
DS06.0	89			50%	50%	50%	0	0	45	0	0	0	45	0
DS6.1	6	100%					6	0	0	0	0	0	0	0
DS06.2	5	100%					5	0	0	0	0	0	0	0
DS06.3	0		50%	50%			0	0	0	0	0	0	0	0
DS07.0	30					100%	0	0	0	0	30	0	0	0
DS07.1	13					100%	0	0	0	0	13	0	0	0
DS07.2	42				50%	50%	0	0	0	21	0	0	0	0
DS8.0	0				100%		0	0	0	0	0	0	0	0
DS8.1	0			100%			0	0	0	0	0	0	0	0
DS09.0	25				100%		0	0	0	25	0	0	0	0
DS10.0	98					100%	0	0	0	0	0	0	0	98
DS11.0	0				100%		0	0	0	0	0	0	0	0
DS12.0	5					100%	0	0	0	0	5	0	0	0
DS12.1	61					100%	0	0	0	0	61	0	0	0
DS12.2	61					100%	0	0	0	0	61	0	0	0
DS12.3	15					100%	0	0	0	0	15	0	0	0
DS12.4	7					100%	0	0	0	0	7	0	0	0
DS13.3	101				30%		0	0	0	30	71	0	0	0
DS14.0	547				30%		0	0	0	164	383	0	0	0
Total	1156						17	28	61	240	667	45	4%	98
OVERALL DOA ESTIMATED														8%
														100%

MIDDLE SCHOOL DOA ESTIMATION FOR 2010-11														
DS Zones	Students	Direction of Approach for each Zone					Traffic Generated from Each Zone							
		NB Rte 15	SB Rte 15	EB Rte 50	WB Rte 50	Lenah Run Circle	NB Rte 15	SB Rte 15	EB Rte 50	WB Rte 50	Braddock	EB Braddock	Lenah Run Circle	TOTAL
DS4.0	28	67%	67%	33%	33%		0	19	9	0	0	0	0	28
DS04.1	12	67%	67%	33%	33%		0	8	4	0	0	0	0	12
DS05	9	67%	67%	33%	33%		6	0	3	0	0	0	0	9
DS06.0	131			50%	50%	50%	0	0	66	0	0	66	0	131
DS6.1	6	100%					6	0	0	0	0	0	0	6
DS06.2	2	100%					2	0	0	0	0	0	0	2
DS06.3	0		50%	50%			0	0	0	0	0	0	0	0
DS07.0	59					100%	0	0	0	0	59	0	0	59
DS07.1	26					100%	0	0	0	0	26	0	0	26
DS07.2	86					50%	0	0	0	43	43	0	0	86
DS8.0	0			100%			0	0	0	0	0	0	0	0
DS8.1	0			100%			0	0	0	0	0	0	0	0
DS08.0	45					100%	0	0	0	45	0	0	0	45
DS10.0	63					100%	0	0	0	0	0	0	63	63
DS11	0					100%	0	0	0	0	0	0	0	0
DS12.0	4					100%	0	0	0	0	4	0	0	4
DS12.1	49					100%	0	0	0	0	49	0	0	49
DS12.2	46					100%	0	0	0	0	46	0	0	46
DS12.3	26					100%	0	0	0	0	26	0	0	26
DS12.4	10					100%	0	0	0	0	10	0	0	10
DS13.3	70					70%	0	0	0	21	49	0	0	70
DS14	355					30%	0	0	0	107	248	0	0	355
Total	1027						14	27	82	216	561	66	63	1027
OVERALL DOA ESTIMATED							1%	3%	8%	21%	55%	6%	6%	100%



APPENDIX E

ITE "TRIP GENERATION HANDBOOK, 2ND EDITION" SAMPLE PROBLEM.



APPENDIX E

ITE "TRIP GENERATION HANDBOOK, 2ND EDITION" SAMPLE PROBLEM.

Problem 7: Estimate trip generation for Land Use Code 530, High School on a weekday during the a.m. peak hour as a function of the number of employees (page 930). For this example, assume the school will have 200 employees.

Step 2: number of employees is within the range of data

Step 3: sufficient number of data points (52)

Step 4: no regression equation provided

Step 5: standard deviation is less than or equal to 110 percent of the weighted average weight (61 percent)

Step 6: weighted average rate line is not within data cluster at site's number of employees.

Collect Local Data

Problem 8: Same as problem 7, except assume the school will have 130 employees.

Step 2: number of employees is within the range of data

Step 3: sufficient number of data points (52)

Step 4: no regression equation provided

Step 5: standard deviation is less than or equal to 110 percent of the weighted average weight (61 percent)

Step 6: weighted average rate line is within data cluster at site's number of employees

Use Weighted Average Rate

Problem 9: Estimate trip generation for Land Use Code 550, University/College on a weekday during the a.m. peak hour of adjacent street traffic as a function of the number of employees (page 997). Assume the university/college will have 1,000 employees.

Step 2: size of site is within the range of data

Step 3: only four data points; but decide to try to use data base

Step 4: regression equation provided

Step 7: less than 20 data points

Step 8A: R^2 of 0.64 is less than 0.75

Step 8B: standard deviation is not less than or equal to 110 percent of the weighted average rate (140 percent)

Collect Local Data at two sites and merge with ITE data base (as described in Chapter 4)

Problem 10: Estimate trip generation for Land Use Code 813, Free-Standing Discount Superstore on a weekday during the p.m. peak hour of generator as a function of gross floor area (page 1,332). For this example, assume the store size will be 180,000 square feet of GFA.

Step 2: size of site is within the range of data

Step 3: sufficient number of data points (nine)

Step 4: regression equation provided

Step 7: less than 20 data points

Step 8A: R^2 of 0.55 is less than 0.75

Step 8B: standard deviation is less than or equal to 110 percent of the weighted average rate (53 percent)

Use Weighted Average Rate

Problem 11: Estimate trip generation for Land Use Code 866, Pet Supply Superstore (page 1,619).

Step 3: only one data point

Collect Local Data



APPENDIX F

SIGNAL WARRANTS

(Based on Estimated Average Daily Traffic - See Note 2)

* Form is based on the sample form found in the Manual on Traffic Signal Design (MTSD) page 20.

TRAFFIC SIGNAL WARRANTS (BG 2010, Route 15 and Braddock Road)

(Based on Estimated Average Daily Traffic - See Note 2)

URBAN		X	RURAL	
1. Minimum Vehicular Urban Not Satisfied Rural				
<i>Number of lanes for moving traffic on each approach</i>				
Major Street	Minor Street		Urban	Rural
1	1		8,000	5,600
2 or more	1		9,600	6,720
2 or more	2 or more		9,600	6,720
1	2 or more		8,000	5,600
			Actual	Actual
			18,790	1,680
			0	1,680
			0	2,400
			0	2,240
			0	2,240
2. Interruption of Continuous Traffic Urban Not Satisfied Rural				
<i>Number of lanes for moving traffic on each approach</i>				
Major Street	Minor Street		Urban	Rural
1	1		12,000	8,400
2 or more	1		14,400	10,080
2 or more	2 or more		14,400	10,080
1	2 or more		12,000	8,400
			Actual	Actual
			18,790	850
			0	850
			0	1,120
			0	1,120
3. Combination Urban Not Satisfied Rural				
			Must satisfy 80% of Warrants 1 and 2	
Must satisfy 80% of Warrants 1 and 2				

Note:

- Left turn movements from the major street may be included with minor street volumes if a separate signal phase is to be provided for the left-turn movement.
- To be used only for NEW INTERSECTIONS or other locations where actual traffic volumes cannot be counted.

* Form is based on the sample form found in the Manual on Traffic Signal Design (MTSD) page 20.

TRAFFIC SIGNAL WARRANTS (TF 2010, Route 15 and Braddock Road)

(Based on Estimated Average Daily Traffic - See Note 2)

URBAN		X		RURAL	
1. Minimum Vehicular		Minimum Required Estimated Average Daily Traffic		Vehicles per day on higher-volume minor street (one direction only)	
Urban	Not Satisfied	Rural		Urban	Actual
Number of lanes for moving traffic on each approach		Number of lanes for moving traffic on each approach		Vehicles per day on major Street (total of both approaches)	
Major Street	Minor Street	Urban	Rural	Urban	Rural
1	1	8,000	5,600	2,400	1,680
2 or more	1	9,600	6,720	2,400	1,680
2 or more	2 or more	9,600	6,720	3,200	2,240
1	2 or more	8,000	5,600	3,200	2,240
2. Interruption of Continuous Traffic		Vehicles per day on major Street (total of both approaches)		Vehicles per day on higher-volume minor street (one direction only)	
Urban	Not Satisfied	Rural		Urban	Actual
Number of lanes for moving traffic on each approach		Number of lanes for moving traffic on each approach		Vehicles per day on major Street (total of both approaches)	
Major Street	Minor Street	Urban	Rural	Urban	Rural
1	1	12,000	8,400	1,200	850
2 or more	1	14,400	10,080	1,200	850
2 or more	2 or more	14,400	10,080	1,600	1,120
1	2 or more	12,000	8,400	1,600	1,120
3. Combination		Must satisfy 80% of Warrants 1 and 2		Must satisfy 80% of Warrants 1 and 2	
Urban	Not Satisfied	Rural			

Note:

- Left turn movements from the major street may be included with minor street volumes if a separate signal phase is to be provided for the left-turn movement.
- To be used only for NEW INTERSECTIONS or other locations where actual traffic volumes cannot be counted.

* Form is based on the sample form found in the Manual on Traffic Signal Design (MTSD) page 20.

TRAFFIC SIGNAL WARRANTS (TF 2011, Route 15 and Braddock Road)

(Based on Estimated Average Daily Traffic - See Note 2)

URBAN		X		RURAL			
1. Minimum Vehicular <div> <div>Urban</div> <div>Not Satisfied</div> <div>Rural</div> </div>							
Number of lanes for moving traffic on each approach <div> <div>Major Street</div> <div>Minor Street</div> </div>		Minimum Required Estimated Average Daily Traffic <div> <div>Vehicles per day on major Street (total of both approaches)</div> <div>Vehicles per day on higher-volume minor street (one direction only)</div> </div>					
<div>1</div> <div>2 or more</div> <div>2 or more</div> <div>1</div>	<div>1</div> <div>1</div> <div>2 or more</div> <div>2 or more</div>	<div>Urban</div> <div>8,000</div> <div>9,600</div> <div>9,600</div> <div>8,000</div>	<div>Rural</div> <div>5,600</div> <div>6,720</div> <div>6,720</div> <div>5,600</div>	<div>Actual</div> <div>19,030</div> <div>0</div> <div>0</div> <div>0</div>	<div>Urban</div> <div>2,400</div> <div>2,400</div> <div>3,200</div> <div>3,200</div>	<div>Rural</div> <div>1,680</div> <div>1,680</div> <div>2,240</div> <div>2,240</div>	<div>Actual</div> <div>860</div> <div>0</div> <div>0</div> <div>0</div>
2. Interruption of Continuous Traffic <div> <div>Urban</div> <div>Not Satisfied</div> <div>Rural</div> </div>		Vehicles per day on higher-volume minor street (one direction only)					
<div>Major Street</div> <div>Minor Street</div>		<div>Urban</div> <div>12,000</div> <div>14,400</div> <div>14,400</div> <div>12,000</div>					
<div>1</div> <div>2 or more</div> <div>2 or more</div> <div>1</div>	<div>1</div> <div>1</div> <div>2 or more</div> <div>2 or more</div>	<div>Rural</div> <div>8,400</div> <div>10,080</div> <div>10,080</div> <div>8,400</div>	<div>Actual</div> <div>19,030</div> <div>0</div> <div>0</div> <div>0</div>	<div>Urban</div> <div>1,200</div> <div>1,200</div> <div>1,600</div> <div>1,600</div>	<div>Rural</div> <div>850</div> <div>850</div> <div>1,120</div> <div>1,120</div>	<div>Actual</div> <div>860</div> <div>0</div> <div>0</div> <div>0</div>	
3. Combination <div> <div>Urban</div> <div>Not Satisfied</div> <div>Rural</div> </div>		Must satisfy 80% of Warrants 1 and 2					
		Must satisfy 80% of Warrants 1 and 2					

Note:

- Left turn movements from the major street may be included with minor street volumes if a separate signal phase is to be provided for the left-turn movement.
- To be used only for NEW INTERSECTIONS or other locations where actual traffic volumes cannot be counted.

* Form is based on the sample form found in the Manual on Traffic Signal Design (MTSD) page 20.



APPENDIX G

















INTERSECTION CAPACITY ANALYSIS RESULTS – FUTURE CONDITIONS
WITH PROPOSED DEVELOPMENT (2011) (INTERSECTIONS 4, 7, AND
8);

TURN LANE WARRANTS (INTERSECTION 8);

TABLE C-1-2.1 FROM VDOT'S "ROAD DESIGN MANUAL"

HCM Unsignalized Intersection Capacity Analysis
9: Lenah Road & School Entrance East

Lenah Schools
TF 2011

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	19	194	7	101	193	6	7	17	64	36	27	27
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	21	211	8	110	210	7	8	18	70	39	29	29
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	216			218			733	692	215	767	692	213
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	216			218			733	692	215	767	692	213
tC, single (s)	4.1			*5.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			*2.7			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			90			97	94	92	85	91	96
cM capacity (veh/h)	1353			1061			275	324	825	254	324	827
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	239	326	96	98								
Volume Left	21	110	8	39								
Volume Right	8	7	70	29								
cSH	1353	1061	566	350								
Volume to Capacity	0.02	0.10	0.17	0.28								
Queue Length 95th (ft)	1	9	15	28								
Control Delay (s)	0.8	3.6	12.6	19.3								
Lane LOS	A	A	B	C								
Approach Delay (s)	0.8	3.6	12.6	19.3								
Approach LOS			B	C								
Intersection Summary												
Average Delay			5.9									
Intersection Capacity Utilization			49.5%		ICU Level of Service					A		
Analysis Period (min)			15									

* User Entered Value

A-212

HCM Unsignalized Intersection Capacity Analysis 8: Lenah Road & School Entrance West









Lenah Schools
TF 2011

	→	↘	↙	←	↗	↖
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↰			↱	↰	↱
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	104	59	215	23	38	137
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	113	64	234	25	41	149
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			177		638	145
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			177		638	145
tC, single (s)			*5.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			*2.7		3.5	3.3
p0 queue free %			79		88	83
cM capacity (veh/h)			1108		348	902
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	177	259	190			
Volume Left	0	234	41			
Volume Right	64	0	149			
cSH	1700	1108	670			
Volume to Capacity	0.10	0.21	0.28			
Queue Length 95th (ft)	0	20	29			
Control Delay (s)	0.0	8.4	12.5			
Lane LOS		A	B			
Approach Delay (s)	0.0	8.4	12.5			
Approach LOS			B			
Intersection Summary						
Average Delay			7.3			
Intersection Capacity Utilization			42.7%		ICU Level of Service	A
Analysis Period (min)			15			

* User Entered Value

HCM Unsignalized Intersection Capacity Analysis 14: Drive # 3 & Lenah Loop Road













Lenah Schools
TF 2011

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	0	301	474	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	327	515	0	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1030	0	0			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1030	0	0			
tC, single (s)	6.4	6.2	*5.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	*2.7			
p0 queue free %	100	70	61			
cM capacity (veh/h)	159	1085	1333			
Direction, Lane #	EB 1	NB 1				
Volume Total	327	515				
Volume Left	0	515				
Volume Right	327	0				
cSH	1085	1333				
Volume to Capacity	0.30	0.39				
Queue Length 95th (ft)	32	46				
Control Delay (s)	9.7	9.4				
Lane LOS	A	A				
Approach Delay (s)	9.7	9.4				
Approach LOS	A					
Intersection Summary						
Average Delay		9.5				
Intersection Capacity Utilization		29.6%		ICU Level of Service		A
Analysis Period (min)		15				

* User Entered Value

HCM Unsignalized Intersection Capacity Analysis
9: Lenah Road & School Entrance East

Lenah Schools
TF 2011

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	7	62	7	25	142	33	7	7	26	14	7	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	67	8	27	154	36	8	8	28	15	8	9
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	190			75			326	331	71	345	317	172
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	190			75			326	331	71	345	317	172
tC, single (s)	4.1			4.1			7.1	6.5	*7.7	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	*4.1	3.5	4.0	3.3
p0 queue free %	99			98			99	99	96	97	99	99
cM capacity (veh/h)	1384			1524			604	575	785	571	585	871
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	83	217	43	32								
Volume Left	8	27	8	15								
Volume Right	8	36	28	9								
cSH	1384	1524	703	635								
Volume to Capacity	0.01	0.02	0.06	0.05								
Queue Length 95th (ft)	0	1	5	4								
Control Delay (s)	0.7	1.1	10.5	11.0								
Lane LOS	A	A	B	B								
Approach Delay (s)	0.7	1.1	10.5	11.0								
Approach LOS			B	B								
Intersection Summary												
Average Delay			2.9									
Intersection Capacity Utilization			26.1%			ICU Level of Service				A		
Analysis Period (min)			15									

* User Entered Value

HCM Unsignalized Intersection Capacity Analysis
8: Lenah Road & School Entrance West

Lenah Schools
TF 2011







	→	↘	↙	←	↘	↙
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↑	↑
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	21	15	54	103	15	55
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	16	59	112	16	60
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			39		260	31
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			39		260	31
tC, single (s)			4.1		6.4	*7.7
tC, 2 stage (s)						
tF (s)			2.2		3.5	*4.1
p0 queue free %			96		98	93
cM capacity (veh/h)			1571		701	836
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	39	171	76			
Volume Left	0	59	16			
Volume Right	16	0	60			
cSH	1700	1571	803			
Volume to Capacity	0.02	0.04	0.09			
Queue Length 95th (ft)	0	3	8			
Control Delay (s)	0.0	2.7	10.0			
Lane LOS		A	A			
Approach Delay (s)	0.0	2.7	10.0			
Approach LOS			A			
Intersection Summary						
Average Delay			4.3			
Intersection Capacity Utilization			26.0%		ICU Level of Service	A
Analysis Period (min)			15			

* User Entered Value

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HCM Unsignalized Intersection Capacity Analysis 14: Drive # 3 & Lenah Loop Road

Lenah Schools
TF 2011

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↑	↑			
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	0	120	118	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	130	128	0	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	257	0	0			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	257	0	0			
tC, single (s)	6.4	*7.7	4.1			
tC, 2 stage (s)						
tF (s)	3.5	*4.1	2.2			
p0 queue free %	100	85	92			
cM capacity (veh/h)	674	878	1623			
Direction, Lane #	EB 1	NB 1				
Volume Total	130	128				
Volume Left	0	128				
Volume Right	130	0				
cSH	878	1623				
Volume to Capacity	0.15	0.08				
Queue Length 95th (ft)	13	6				
Control Delay (s)	9.8	7.4				
Lane LOS	A	A				
Approach Delay (s)	9.8	7.4				
Approach LOS	A					
Intersection Summary						
Average Delay	8.6					
Intersection Capacity Utilization	10.8%		ICU Level of Service		A	
Analysis Period (min)	15					

* User Entered Value

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Left Turn Lane Warrant Analysis (2-LANE) (2020 TF)

Greenvest Road/Site Drive #3 (NBL)

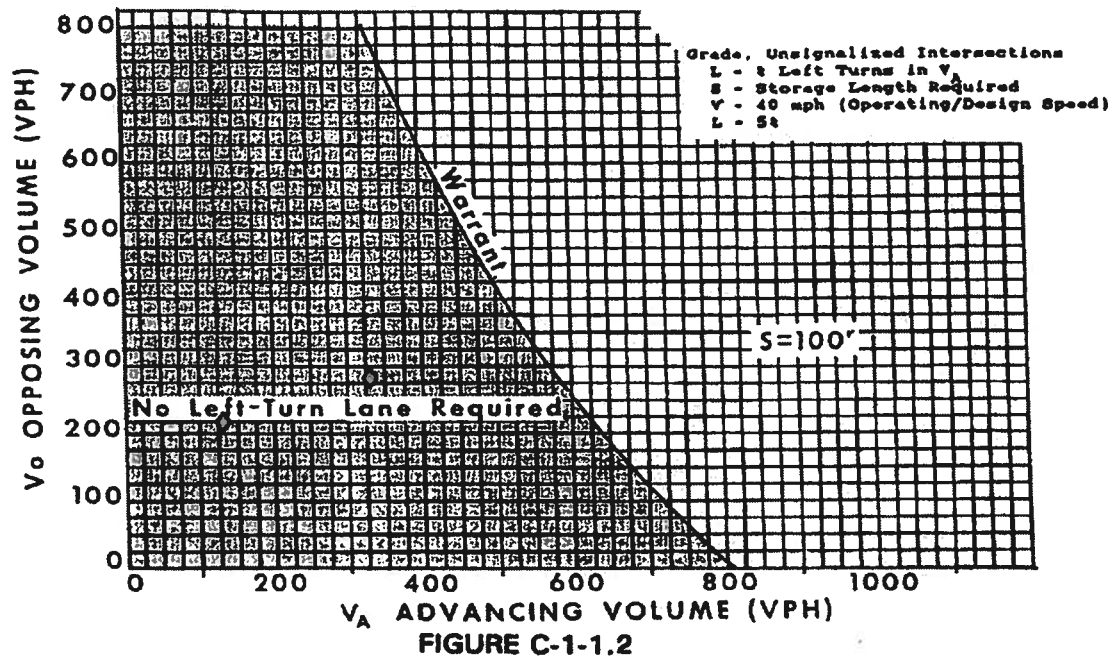
AM Peak Hour

Left Turn Volume = **470** veh/hour
Advancing Volume = **339** veh/hour
Opposing Volume = **278** veh/hour

PM Peak Hour

Left Turn Volume = **117** veh/hour
Advancing Volume = **132** veh/hour
Opposing Volume = **202** veh/hour

WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAYS



Left Turn Lane **Not Required**.

Guidelines for Right Turn Treatments *Two-Lane Highways*

Project Number: 2110-002 Lenah School
 Intersection: Greenvest Road and Site Drive 3
 Movement: SB Right Turn into Site Drive 3
 Analyst: AG

Condition	PHV Approach Total	PHV Right Turns	Taper Threshold	Full Lane Threshold	Treatment
1 2020 TF AM	278	57	42	83	Taper Required
2 2020 TF PM	202	14	50	93	Radius Required
3					
4					
5					
6					

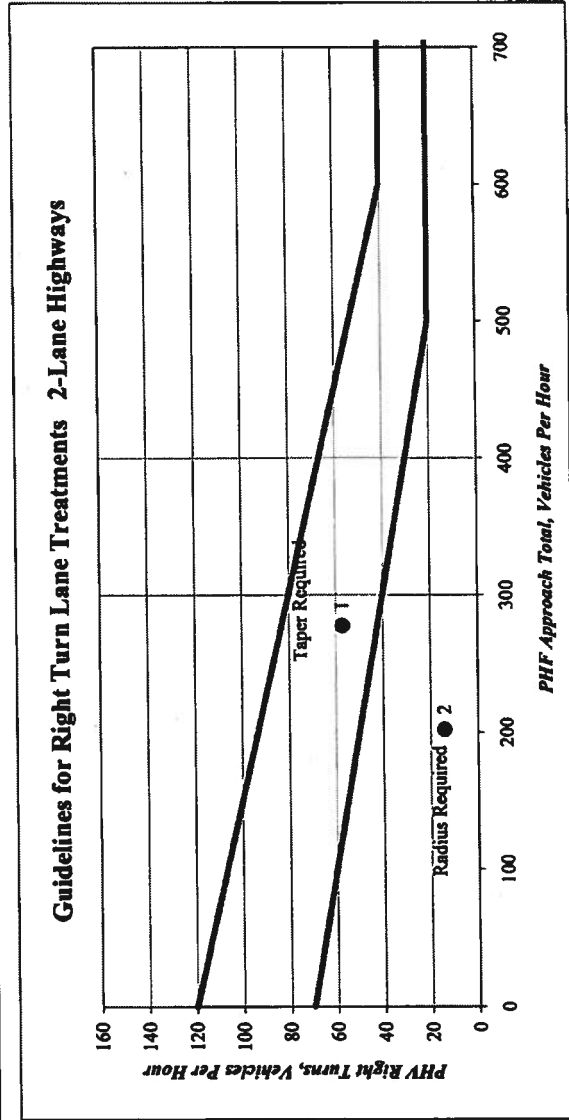


CHART VALUE OF STORAGE LANE REQUIRED	% TL=% TRUCKS IN VPH turning left					
	0%	10%	20%	30%	40%	50%
100'	0'	25'	25'	50'	50'	50'
125'	0'	25'	25'	50'	50'	75'
150'	0'	25'	50'	50'	75'	75'
175'	0'	25'	50'	75'	75'	100'
200'	0'	25'	50'	75'	100'	100'
250'	0'	25'	50'	75'	100'	125'
300'	0'	50'	75'	100'	125'	150'
350'	0'	50'	75'	125'	150'	175'
400'	0'	50'	100'	125'	175'	200'
450'	0'	50'	100'	150'	200'	225'
500'	0'	50'	100'	150'	200'	250'

TABLE C-1-2.1 TRUCK ADJUSTMENTS

**STORAGE LENGTH TO BE ADDED TO CHART VALUES OF LEFT-TURN LANE
STORAGE LENGTHS (Length in Feet)**

For additional information see Highway Research Report Number 211, Volume Warrants for the Left Turn Storage Lanes at Unsignalized Grade Intersections.



APPENDIX H

FIGURE 5: EXISTING (2007) AM/PM PEAK HOUR LEVELS OF SERVICE

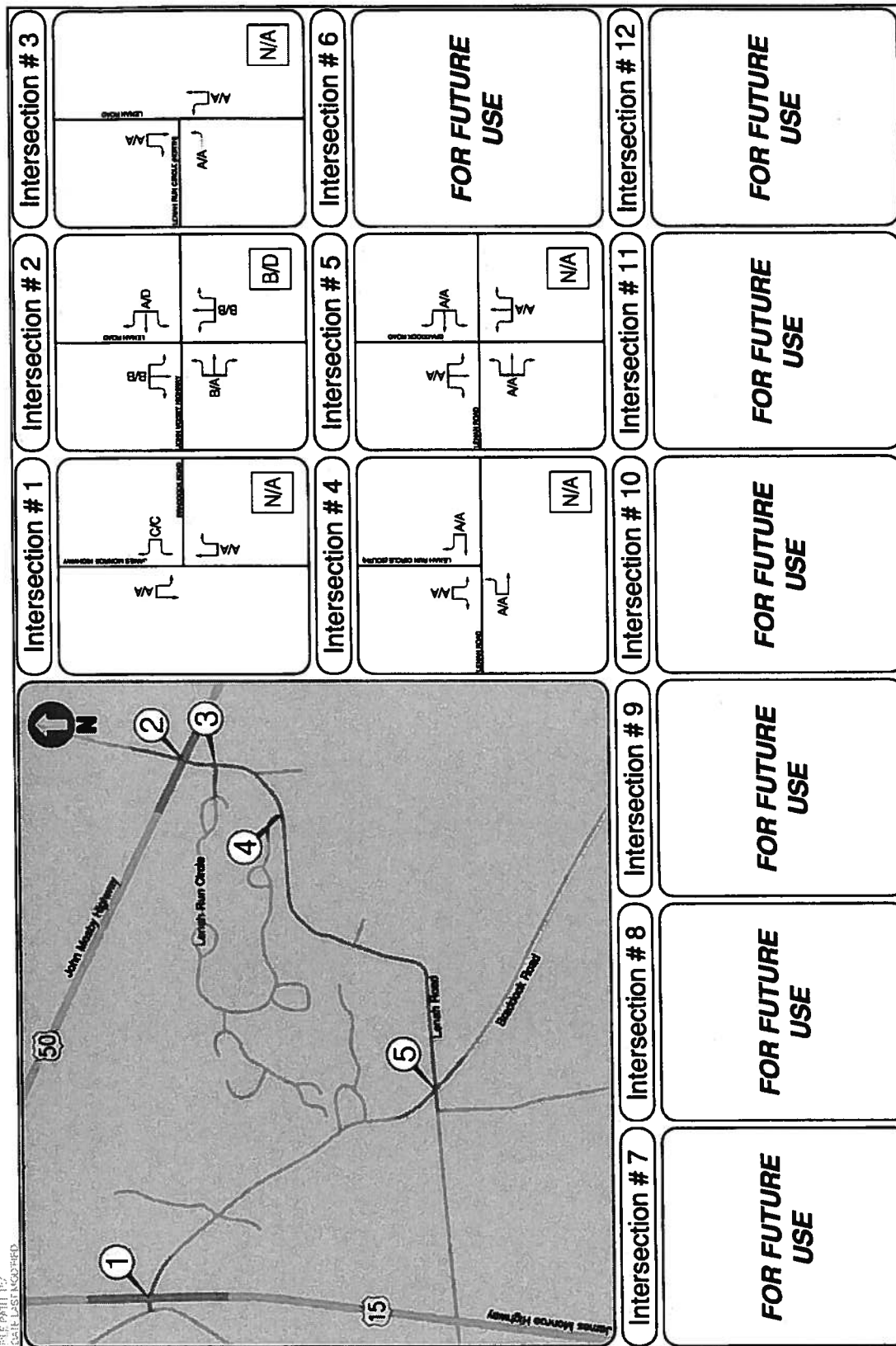


Figure 5
Existing (2007) AM/PM Peak Hour Levels of Service

Legend

- Existing Roadway Network
- Peak Hour Level of Service (By Intersection Approach)
- Peak Hour Level of Service (Overall Signalized Intersection)
- Peak Hour Level of Service Not Available (Overall Unsignalized Intersection)



APPENDIX I

**INTERSECTION CAPACITY ANALYSIS RESULTS FOR NODE 12 (RT. 50
AND LENA) – FUTURE CONDITIONS WITH PROPOSED DEVELOPMENT
(2011 AM)**

HCM Signalized Intersection Capacity Analysis
12: Route 50 & Lenah Road

Lenah Schools
6/18/2008

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱	↰	↱			↰	↱		↕	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Fr _t		1.00	0.85	1.00	1.00			1.00	0.85		0.93	
Flt Protected		1.00	1.00	0.95	1.00			0.95	1.00		0.98	
Satd. Flow (prot)		1863	1583	1770	1861			1770	1583		1695	
Flt Permitted		1.00	1.00	0.06	1.00			0.76	1.00		0.90	
Satd. Flow (perm)		1862	1583	106	1861			1409	1583		1563	
Volume (vph)	2	1159	108	218	525	3	73	0	299	1	0	1
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	1260	117	237	571	3	79	0	325	1	0	1
RTOR Reduction (vph)	0	0	37	0	0	0	0	0	67	0	1	0
Lane Group Flow (vph)	0	1262	80	237	574	0	0	79	258	0	1	0
Turn Type	Perm		Perm	pm+pt		Perm		pm+ov		Perm		
Protected Phases		2		1	6			8	1		4	
Permitted Phases	2		2	6		8		8	8	4		
Actuated Green, G (s)		65.0	65.0	79.2	79.2			10.8	20.0		10.8	
Effective Green, g (s)		66.0	66.0	80.2	80.2			11.8	22.0		11.8	
Actuated g/C Ratio		0.66	0.66	0.80	0.80			0.12	0.22		0.12	
Clearance Time (s)		5.0	5.0	5.0	5.0			5.0	5.0		5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		1229	1045	255	1493			166	412		184	
v/s Ratio Prot				c0.09	0.31				c0.06			
v/s Ratio Perm		c0.68	0.05	0.65				0.06	0.10		0.00	
v/c Ratio		1.03	0.08	0.93	0.38			0.48	0.63		0.01	
Uniform Delay, d1		17.0	6.1	36.7	2.8			41.2	35.3		38.9	
Progression Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2		32.7	0.1	37.3	0.8			2.1	3.0		0.0	
Delay (s)		49.7	6.2	74.0	3.6			43.4	38.2		38.9	
Level of Service		D	A	E	A			D	D		D	
Approach Delay (s)		46.1			24.2			39.2			38.9	
Approach LOS		D			C			D			D	
Intersection Summary												
HCM Average Control Delay			38.2			HCM Level of Service			D			
HCM Volume to Capacity ratio			0.97									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			106.1%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

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



















APPENDIX J

**INTERSECTION CAPACITY ANALYSIS RESULTS FOR NODE 12 (RT. 50
AND LENA) – FUTURE CONDITIONS WITH PROPOSED DEVELOPMENT
(2011 PM)**

HCM Signalized Intersection Capacity Analysis
12: Route 50 & Lenah Road

Lenah Schools
6/18/2008

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00			1.00	0.85		0.88	
Flt Protected		1.00	1.00	0.95	1.00			0.95	1.00		1.00	
Satd. Flow (prot)		1863	1583	1770	1862			1777	1583		1628	
Flt Permitted		1.00	1.00	0.17	1.00			0.73	1.00		0.97	
Satd. Flow (perm)		1863	1583	320	1862			1352	1583		1588	
Volume (vph)	0	892	30	245	1570	2	29	1	79	1	0	8
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	970	33	266	1707	2	32	1	86	1	0	9
RTOR Reduction (vph)	0	0	9	0	0	0	0	0	72	0	8	0
Lane Group Flow (vph)	0	970	24	266	1709	0	0	33	14	0	2	0
Turn Type	Perm		Perm	pm+pt		Perm		pm+ov		Perm		
Protected Phases		2		1	6			1			4	
Permitted Phases	2		2	6		8		8		4		
Actuated Green, G (s)		70.3	70.3	83.4	83.4			6.6	14.7		6.6	
Effective Green, g (s)		71.3	71.3	84.4	84.4			7.6	16.7		7.6	
Actuated g/C Ratio		0.71	0.71	0.84	0.84			0.08	0.17		0.08	
Clearance Time (s)		5.0	5.0	5.0	5.0			5.0	5.0		5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		1328	1129	402	1572			103	328		121	
v/s Ratio Prot		0.52		0.06	c0.92				0.00			
v/s Ratio Perm			0.01	0.50				c0.02	0.01		0.00	
v/c Ratio		0.73	0.02	0.66	1.09			0.32	0.04		0.01	
Uniform Delay, d1		8.6	4.2	11.9	7.8			43.8	35.0		42.7	
Progression Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2		3.6	0.0	4.1	50.3			1.8	0.1		0.0	
Delay (s)		12.2	4.2	15.9	58.1			45.6	35.0		42.8	
Level of Service		B	A	B	E			D	D		D	
Approach Delay (s)		11.9			52.5			37.9			42.8	
Approach LOS		B			D			D			D	
Intersection Summary												
HCM Average Control Delay			38.8			HCM Level of Service			D			
HCM Volume to Capacity ratio			1.02									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			148.0%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												




















APPENDIX K

**INTERSECTION CAPACITY ANALYSIS RESULTS FOR NODE 12 (RT. 50
AND LENA) – FUTURE CONDITIONS WITH PROPOSED DEVELOPMENT
(2011) USING PEAK HOUR OF GENERATOR**

HCM Signalized Intersection Capacity Analysis 12: Route 50 & Lenah Road


















Lenah Schools
TF 2011 (Peak Hour of Generator)

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0			4.0			4.0	
Lane Util. Factor		1.00		1.00	1.00			1.00			1.00	
Frt		0.99		1.00	1.00			0.90			0.95	
Flt Protected		1.00		0.95	1.00			0.99			0.98	
Satd. Flow (prot)		1838		1770	1861			1655			1750	
Flt Permitted		1.00		0.07	1.00			0.91			0.88	
Satd. Flow (perm)		1838		126	1861			1527			1567	
Volume (vph)	0	999	111	213	580	3	85	0	245	1	1	1
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1052	117	224	611	3	89	0	258	1	1	1
RTOR Reduction (vph)	0	19	0	0	0	0	0	119	0	0	1	0
Lane Group Flow (vph)	0	1150	0	224	614	0	0	228	0	0	2	0
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases	2			1			8			4		
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	54.0			64.7			15.3			15.3		
Effective Green, g (s)	55.0			65.7			16.3			16.3		
Actuated g/C Ratio	0.61			0.73			0.18			0.18		
Clearance Time (s)	5.0			5.0			5.0			5.0		
Vehicle Extension (s)	3.0			3.0			3.0			3.0		
Lane Grp Cap (vph)	1123			214			277			284		
v/s Ratio Prot	0.63			c0.08								
v/s Ratio Perm				c0.68			c0.15			0.00		
v/c Ratio	1.02			1.05			0.82			0.01		
Uniform Delay, d1	17.5			30.9			35.5			30.2		
Progression Factor	1.00			1.00			1.00			1.00		
Incremental Delay, d2	33.0			74.3			17.7			0.0		
Delay (s)	50.5			105.3			53.3			30.2		
Level of Service	D			F			D			C		
Approach Delay (s)	50.5			32.5			53.3			30.2		
Approach LOS	D			C			D			C		
Intersection Summary												
HCM Average Control Delay	44.5			HCM Level of Service					D			
HCM Volume to Capacity ratio	0.98											
Actuated Cycle Length (s)	90.0			Sum of lost time (s)					8.0			
Intersection Capacity Utilization	124.0%			ICU Level of Service					H			
Analysis Period (min)	15											
c Critical Lane Group												

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HCM Signalized Intersection Capacity Analysis
12: Route 50 & Lenah Road

Lenah Schools
TF 2011 (Peak Hour of Generator)

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0			4.0			4.0	
Lane Util. Factor		1.00		1.00	1.00			1.00			1.00	
Fr _t		1.00		1.00	1.00			0.91			0.98	
Flt Protected		1.00		0.95	1.00			0.99			0.96	
Satd. Flow (prot)		1854		1770	1862			1667			1748	
Flt Permitted		1.00		0.20	1.00			0.91			0.61	
Satd. Flow (perm)		1854		368	1862			1531			1113	
Volume (vph)	0	867	32	188	1595	3	31	5	80	5	0	1
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	913	34	198	1679	3	33	5	84	5	0	1
RTOR Reduction (vph)	0	1	0	0	0	0	0	79	0	0	1	0
Lane Group Flow (vph)	0	946	0	198	1682	0	0	43	0	0	5	0
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		72.7		85.0	85.0			5.0			5.0	
Effective Green, g (s)		73.7		86.0	86.0			6.0			6.0	
Actuated g/C Ratio		0.74		0.86	0.86			0.06			0.06	
Clearance Time (s)		5.0		5.0	5.0			5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)		1366		433	1601			92			67	
v/s Ratio Prot		0.51		0.04	c0.90							
v/s Ratio Perm				0.36				c0.03			0.00	
v/c Ratio		0.69		0.46	1.05			0.47			0.08	
Uniform Delay, d1		7.1		7.5	7.0			45.5			44.4	
Progression Factor		1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2		2.9		0.8	37.1			3.7			0.5	
Delay (s)		10.0		8.3	44.1			49.2			44.9	
Level of Service		A		A	D			D			D	
Approach Delay (s)		10.0			40.3			49.2			44.9	
Approach LOS		A			D			D			D	
Intersection Summary												
HCM Average Control Delay			31.0			HCM Level of Service				C		
HCM Volume to Capacity ratio			1.01									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			148.2%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												